SAMPLING AND ANALYSIS PLAN

for

2004 Monitoring of the Missouri River in Nebraska

Project Number: AMB-NEMORR-001

Prepared By:

U.S. Army Corps of Engineers – Omaha District

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1. PROJECT DESCRIPTION

1.1. INTRODUCTION

The U.S. Army Corps of Engineers (USACE) and the Nebraska Department of Environmental Quality (NDEQ) both have an interest in the water quality of the Missouri River along Nebraska's border. Partnering in collecting water quality data for the Missouri River will be cost effective for both the USACE and NDEQ.

The partnering of water quality data collection efforts for the Missouri River in Nebraska will allow the Omaha District to better meet the water quality management requirements specified in the USACE's Engineer Regulation ER 1110-2-8154, "Water Quality and Environmental Management for Corps Civil Works Projects" (USACE, 1995). The proposed partnering arrangement with the NDEQ will allow the Omaha District to more comprehensively evaluate water quality conditions of the Missouri River in Nebraska. ER 1110-2-8154 encourages the Omaha District to partner with other governmental and nongovernmental entities in data collection efforts because it is cost-effective. Paragraph 9d of ER 1110-2-8154 states: "Partnering of data collection efforts with other governmental and nongovernmental entities is encouraged and is cost effective." Paragraph 10c of ER 1110-2-8154 states: "When designing water quality studies or developing or revising water control plans, the views of other Federal, state, and local agencies regarding data requirements must be fully considered. Data collection is costly and labor-intensive; therefore, every opportunity to share data and partner the data collection effort must be exercised."

Partnering with the USACE to monitor the Missouri River in Nebraska will allow the NDEQ to better meet its water quality management requirements under Sections 305(b), 303(d), and 319 of the Federal Clean Water Act.

1.2. PROJECT RESPONSIBILITIES

1.2.1. Organizations Participating in Project

The organizations participating in this monitoring project include the USACE – Omaha District and the NDEQ. Within each of these organizations the entities implementing the project are: USACE – Water Quality Unit and Environmental Chemistry Branch (ECB) Laboratory (Omaha), and NDEQ – Water Quality Assessment Section. A relational organization chart listing functional responsibilities and lines of communication is provided in Figure 1.

1.2.2. Staff Responsibilities and Contacts

<u>USACE Staff Responsibilities</u>
Overall Project Coordination: Dave Jensen (402)-221-4622
Sample Collection: Nathan Birks (402)-221-4587
Sampling Coordination – USACE: Bill Otto (402)-221-4803
Data Quality Review – Verification: Nathan Birks
Data Quality Review – Validation: Dave Jensen
Laboratory Analysis – USACE/ECB: Dan Sanders (402-444-4322), Prem Arora (402-444-4318)
Data Entry and Management: Nathan Birks
Data Evaluation and Reporting: Dave Jensen
<u>NDEQ Contact</u>
Overall Project Coordination – NDEQ: John Lund (471-4709)

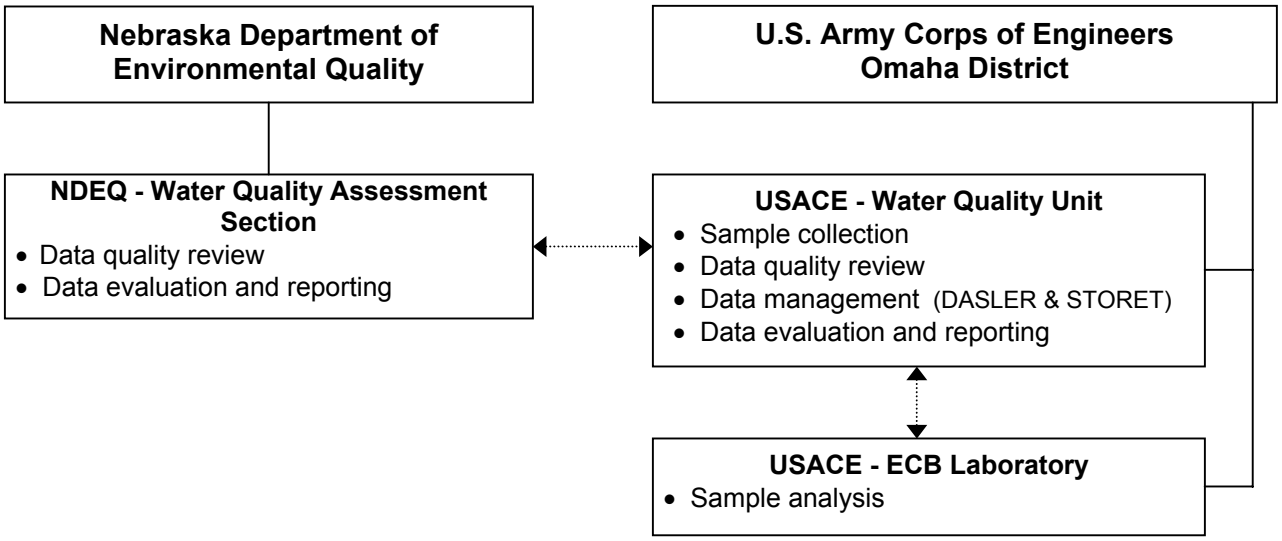

Figure 1. Organizational chart showing relationships, functional responsibilities, and lines of communication (dotted lines) for entities participating in the project.

1.3. BACKGROUND INFORMATION

1.3.1. USACE Surface Water Quality Monitoring Strategy

To facilitate implementation of its water quality management program, the Omaha District has identified five goals and 16 monitoring objectives for surface water quality monitoring (USACE, 2003a). The water quality monitoring implemented through this project will address half of the 16 identified monitoring objectives. The eight monitoring objectives that will be addressed are:

Purpose: Determine surface water quality conditions at USACE projects.

- Characterize the spatial and temporal distribution of water quality conditions at USACE projects.

- Determine if water quality conditions attributed to the operation of USACE projects are improving, degrading, or staying the same over time.

Purpose: Determine if any surface water quality concerns exist that are due to the operation of Corps projects.

- Determine if water quality conditions at Corps projects or attributable to the operation of Corps projects (i.e., downstream conditions resulting from reservoir discharges) meet applicable Federal, state, and local water quality standards.

- Assess water quality conditions at Corps projects in relation to potential sources, transport, fate, and effects of contaminants.

- Identify pollutants and their sources that are affecting water quality and the aquatic environment at Corps projects.

Purpose: Provide data to support reservoir regulation elements at Corps projects for effective management and enhancement of surface water quality and the aquatic environment.

- Provide water quality data required for real-time regulation of Corps projects.

- Collect the information needed to design, engineer, and implement measures or modifications at Corps projects to enhance surface water quality and the aquatic environment.

Purpose: Evaluate the effectiveness of structural or operational measures implemented at Corps projects to enhance surface water quality and/or the aquatic environment.

- Evaluate the effectiveness of implemented measures at Corps projects to improve water quality and the aquatic environment.

1.3.2. NDEQ Surface Water Monitoring Strategy

To facilitate implementation of its water quality management program, the NDEQ has developed a surface water quality monitoring strategy under its Continuing Planning Process (NDEQ, 2001). This strategy identifies 10 monitoring categories and a total of 44 monitoring objectives for surface water quality monitoring. The water quality monitoring implemented through this project will primarily or secondarily address 16 surface water quality monitoring objectives. The 16 monitoring objectives that will be addressed are:

NPDES Program Implementation:

- Determine the need to establish water quality-based effluent limits within National Pollutant Discharge Elimination System (NPDES) discharge permits.

- Develop Wasteload Load Allocations (WLAs) for appropriate pollutants and receiving water where water quality-based permit limits are required for a facility and a Total Maximum Daily Load (TMDL) is not needed.

Nonpoint Source Management Program Implementation

- Identify waterbodies, and their corresponding watersheds, where surface water quality and/or beneficial uses are impaired or imminently threatened by nonpoint source pollution.

Water Quality Standards Development and Implementation

- Define baseline water quality conditions for each designated State Resource Water Class A and B.

- Obtain representative range of concentrations and loadings for total N, total P, chlorophyll *a*, and turbidity (or secchi depth) from waterbodies in each ecoregion of Nebraska for future nutrient criteria development.

Water Quality Assessment – Status and Trends (305b Report)

- Characterize the broad-scale geographic and seasonal distribution of the water quality conditions of the state's surface water resources.

- Evaluate geographic and seasonal distributions of water quality conditions of the state's surface water resources in relation to the sources, transport, fate, and effects of contaminants.

- Assess surface water conditions in the state to accurately determine if individual waterbodies are supporting their designated beneficial uses.

- Determine if surface water quality conditions in the state are improving, degrading, or staying the same over time.

Basin Management Planning – Identification and Quantification of Water Quality Problems and Issues within River Basins

- Identify waterbodies where designated beneficial uses are impaired or imminently threatened by point source, nonpoint source or a combination of point and nonpoint source pollutants or pollution.

- Identify the pollutant(s) or pollution, and its source(s), that is contributing to beneficial use impairment.

- Estimate the existing instream loads for targeted pollutants and waterbodies.

- Determine the pollution loading/assimilative capacity for targeted pollutants and waterbodies based on hydrologic conditions (i.e., by 10^{th} percentile flows).

- Characterize the seasonal/temporal and if possible the spatial variation associated with pollution loads for targeted pollutants and waterbodies.

- Determine the pollution load contributed by individual point sources, nonpoint sources, and natural background loading for targeted pollutants and watersheds.

- Determine appropriate design conditions for pollution management within a river basin.

1.4. DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) are qualitative and quantitative statements that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions. In this context, the following DQOs have been identified for this monitoring project.

1.4.1. Project Monitoring Objectives

The data collected through this monitoring project are meant to address, in whole or part, monitoring objectives 2, 3, 4, 5, 9, 14, 15, and 16 identified by the USACE in their "Strtegic Plan and Guidance for Implementing the Omaha District's Water Quality Management Program" (see Section 1.3.1), and 16 monitoring objectives identified by the NDEQ for surface water quality management (see Section 1.3.2).

1.4.2. Types of Data Needed

To meet the project's monitoring objectives, ambient water quality monitoring will be conducted at seven Missouri River locations along the Nebraska/Iowa and Nebraska/South Dakota borders. The ambient monitoring to be undertaken will include near-surface sampling at a mid-channel location. Water temperature data currently being recorded at several U.S. Geological Survey (USGS) and USACE stream gages on the river below Gavins Point Dam will be accessed (see Table 1).

Parameters to be monitored are those necessary to assess water quality conditions and trends, beneficial use attainment, and pollutant loadings. Measurement of water quality parameters and explanatory variables are both needed. Water quality parameters to be monitored include field measurements (i.e., water temperature, dissolved oxygen, pH, conductivity, and turbidity), alkalinity, suspended solids, nutrients, pesticides, total organic carbon, chloride, chemical oxygen demand, and selected metals. The one explanatory variable to be quantified is instantaneous flow.

1.4.3. Quality of Data Needed

The quality of the data collected needs to be at a level that meets the NDEQ's and USACE's assessment and reporting requirements. The NDEQ will use the data to meet the Clean Water Act's Section 305(b), 303(d), and 319 assessment and reporting requirements. The USACE will use the data to prepare annual water quality reports and facilitate the preparation of project-specific reports required under the USACE's ER 1110-2-8154.

1.5. PROJECT/TASK DESCRIPTION

1.5.1. Sample Collection and Analysis

Sample collection will be the responsibility of the USACE. Samples collected by the USACE will be analyzed by the USACE's ECB Omaha laboratory.

1.5.2. Data Quality Review

The USACE will be responsible for reviewing the data quality of all field measurements and the analytical results provided by the ECB Laboratory. Data quality review is to address both data verification and validation and be conducted in accordance with water quality SOP number WQ-27202, "Data Quality Review" (USACE, 2003b). The NDEQ will review the data provided by the USACE, and notify the USACE of any identified data quality concerns.

1.5.3. Data Management

The USACE and NDEQ will independently manage the collected data for their use. The USACE will initially store the quality-reviewed data in their in-house DASLER database. The USACE will provide a copy of the collected data to the NDEQ. The USACE will also up-load the collected data stored in DASLER to EPA's STORET database under the USACE Omaha District's organization code.

1.5.4. Data Assessment and Reporting

Both the USACE and NDEQ are free to assess, use, and report on the collected data to meet their individual needs.

1.6. DOCUMENTS AND RECORDS

The USACE Project Coordinator will be responsible for distributing a copy of the final SAP, and any subsequent revisions, to persons identified on the distribution list.

The USACE will provide the NDEQ an electronic copy of the collected data after it has been data quality reviewed. The electronic copy of the final data will be in Microsoft EXCEL format or other agreed to format.

The USACE will maintain the original field sheets and laboratory analytical reports for at least three years. The retention of these materials after that time will be in accordance with the USACE's records management procedures.

2. DATA COLLECTION APPROACH

2.1. DATA COLLECTION DESIGN

Data collection under this project will occur at 9 locations on the Missouri River along the Nebraska/South Dakota and Nebraska/Iowa border. Site locations and station numbers are listed in Table 1 and shown in Figure 2.

2.1.1. Sample Collection and Frequency

2.1.1.1. Biweekly Sampling (April – September) – Monthly Sampling (October - March)

Grab samples and field measurements will be collected at all seven locations. Grab samples will be collected biweekly (i.e., every other week) from April through September, and monthly from October through March. The grab samples will be collected at a mid-channel (i.e., thalweg) location, and will be taken just below the water surface. If winter ice conditions do not allow for boat access, field measurements and samples, if allowable, will be collected near the bank. At least 11 days, but not more than 17 days, is to separate the biweekly sampling; and at least 21 days, but not more than 35 days, is to separate the monthly monitoring at each site. Extreme ice conditions may preclude the data collection during winter months. Additional sampling may be conducted under runoff events if it is determined that the biweekly and monthly sampling is not adequately monitoring water quality under runoff conditions.

Table 1. Water quality monitoring station numbers, names, and locations.

Water Quality Station Number*	Name	Location
1FTRRRTW1(A or B)	Missouri River Fort Randall Dam Tailwaters	Approximately 1 mile downstream of Fort Randall Dam at Missouri River Mile 878. (Latitude: 43°02'53.8" N, Longitude: 98°32'21.9" W)
1MORRR0851(A or B)	Missouri River near Verdel, NE	Approximately 2 miles upstream of the confluence of the Niobrara River. Near USGS gaging site 06453620 at Missouri River Mile 851. (Latitude: 42°50'05.7" N, Longitude: 98°08'21.6" W)
1GPTRRTW1(A or B)	Missouri River Gavins Point Dam Tailwaters	Approximately 1 mile downstream of Gavins Point Dam at Missouri River Mile 810. (Latitude: 42°50'52.1" N, Longitude: 97°27'36.0" W)
1MORRR0774(A or B)	Missouri River near Maskell, NE	Just downstream of Highway 19 bridge at Mulberry Bend Wildlife Management Area. Near USGS gaging site 06478526 at Missouri River Mile 775. (Latitude: 42°42'56.7" N, Longitude: 96°56'43.8" W)
1MORRR0753(A or B)	Missouri River near Ponca, NE	At Ponca State Park, NE at Missouri River Mile 753. (Latitude: 42°36'15.5" N, Longitude: 96°42'47.0" W)
1MORRR0691(A or B)	Missouri River at Decatur	At the Highway 175 bridge. Near USGS gaging site 06601200 at Missouri River Mile 691. (Latitude: 42°00'22.5" N, Longitude: 96°14'30.7" W)
1MORRR0619(A or B)	Missouri River at Omaha	Approximately 3 miles upstream of the Interstate 480 bridge. Near USGS gaging site 06610000 at Missouri River Mile 619. (Latitude: 41°17'06.8" N, Longitude: 95°52'37.5" W)
1MORRR0563(A or B)	Missouri River at Nebraska City	Approximately 1 miles upstream of the Highway 2 bridge at Riverview Park. Near USGS gaging site 06807000 at Missouri River Mile 563. (Latitude: 40°41'15.5" N, Longitude: 95°50'47.1" W)
1MORRR0498(A or B)	Missouri River at Rulo	Just downstream of the Highway 159 bridge. Near USGS gaging station 06813500 at Missouri River Mile 498. (Latitude: 40°03'01" N, Longitude: 95°25'12" W)

* A and B are collection site identifiers: A = mid-channel of river, B = next to riverbank.

2.1.1.2. Continuous Water Temperature Monitoring

Hourly water temperature is currently being recorded at four USGS gage sites on the Missouri River below Gavins Point Dam within the Omaha District. The four sites are the Sioux City, Iowa gage (USGS 06486000), Decatur, Nebraska gage (USGS 06601200), Omaha, Nebraska gage (USGS 06610000), and Nebraska City, Nebraska gage (USGS 06807000). A continuous temperature recorder is also installed and maintained by the USACE at the Fort Randall and Gavins Point Dam powerhouses. The water temperature data at these sites represents the following conditions:

- The Fort Randall Dam site will represent conditions at the start of the upper, un-channelized reach of the Missouri River that is directly influenced by the Fort Randall Dam releases.
- The Gavins Point Dam site will represent conditions at the start of the lower, un-channelized reach of the Missouri River that is directly influenced by the Gavins Point Dam releases.

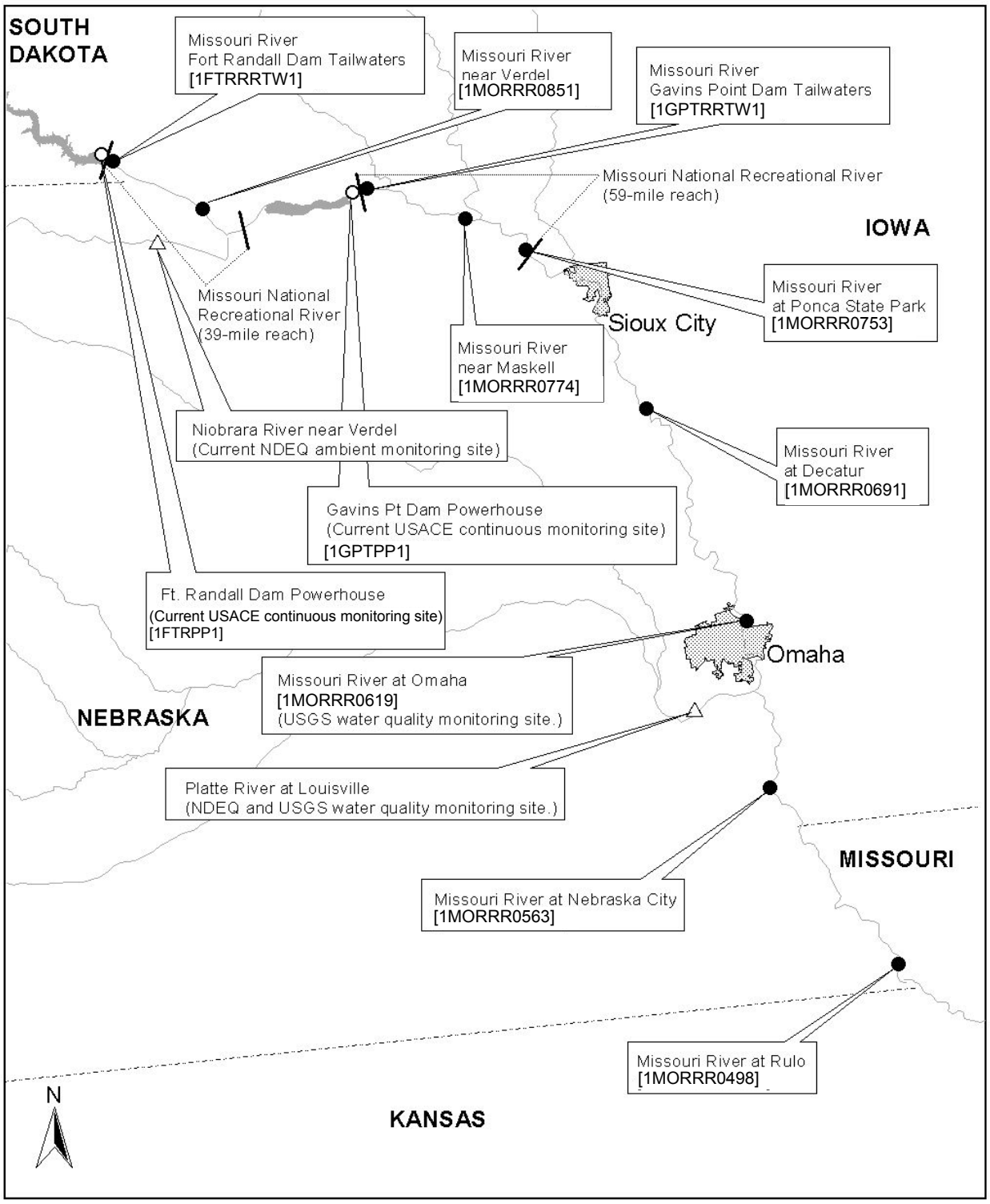

Figure 2. Locations of monitoring sites along the Missouri River from Ft. Randall Dam to Rulo, Nebraska.

● Location of sites to be monitored as part of this project.

- The Sioux City site (USGS 06486000) represents conditions at the end of the un-channelized reach and start of the lower, channelized reach of the Missouri River. This gage is located just below the confluence of the Big Sioux River and may not represent completely mixed conditions between the Missouri and Big Sioux Rivers.
- The Decatur site represents conditions below Sioux City, Iowa and the Big Sioux River.
- The Omaha site represents conditions in the Omaha area and below the Ft. Calhoun and North Omaha power-plants.
- The Nebraska City site represents conditions below Omaha, the Platte River, and the Lake Manawa power-plant; and above the Nishnabotna River and the Nebraska City and Cooper power-plants.

Note: Consideration will be given to continuously monitor water temperature at the USGS gage at Rulo, NE (USGS 06813500).

2.1.2. Parameters to be Measured and Analyzed

2.1.2.1. Water Quality Parameters

The water quality parameters that are to be monitored at the seven sampling locations and their frequency of analyses are listed in Table 2.

Table 2. Parameters to be monitored and their frequency of analysis.

Parameter	Frequency of Analyses	Parameter	Frequency of Analyses
Field Measurements: • Water Temperature • pH • Dissolved Oxygen • Conductivity • Turbidity	Biweekly/Monthly	Laboratory Analysis: • Total Suspended Solids • Alkalinity • Chloride • Total Ammonia • Nitrate/Nitrite • Total Kjeldahl Nitrogen • Total Phosphorus • Total Organic Carbon • Chemical Oxygen Demand • Pesticides, Immunoassay**	Biweekly/Monthly
Laboratory Analysis: • Metals, Dissolved* • Mercury, Total • Selenium, Total • Hardness (Calculated)	Quarterly (January April, July, October)		
Laboratory Analysis: • Pesticides, Full Scan***	Annually (May)		

* Dissolved metals to be analyzed include: calcium, magnesium, sodium, arsenic, cadmium, chromium, copper, mercury, nickel, lead, silver, and zinc.

** Parameters to be analyzed include: alachlor, atrazine, and metolachlor.

*** Parameters to be analyzed include: acetochlor, alachlor, atrazine, benfluralin, butylate, chlorpyrifos, cyanazine, cycloate, EPTC, hexazinone, isopropalin, metolachlor, metribuzin, molinate, oxadiazon, oxyfluorfen, pebulate, pendimethalin, profluralin, prometon, propachlor, propazine, simazine, trifluralin, and vernolate.

2.1.2.2. Explanatory Variables

An explanatory variable that will be quantified is the flow of the river at the time of sampling.

2.2. MEASUREMENT AND SAMPLING METHODS

2.2.1. Field Observations and Measurements

The field sheet that will be used to record field observations and measurements is shown in Attachment 1. Field observations may be made at all sites. Water temperature, pH, conductivity, dissolved oxygen, and turbidity measurements will be taken using a "Hydrolab 4" equipped with a DataSonde 4 probe and Surveyor 4 data logger. The Hydrolab will be operated as specified in the USACE – Water Quality Unit's SOP Number WQ-21201, "Using a Hydrolab 4 to Directly Measure Water Quality" (USACE, 2004a). Secchi depth measurements will be obtained by immersing a standard black and white Secchi disk as specified in the USACE – Water Quality Unit's SOP Number WQ-21105, "Determining Secchi Depth" (USACE, 2004b). River depth at time of sampling at the monitoring location will be recorded from a "fish finder-type" depth recorder.

2.2.2. Continuous Temperature Monitoring

See Section 2.1.1.2.

2.2.3. Water Quality Sample Collection

All samples will be collected by dipping a plastic bucket just below the surface of the water. The plastic bucket will be equipped with a churn and spigot. The appropriate sample containers will be filled from the spigot of the plastic bucket, as the water is churned, and appropriately preserved.

2.2.3.1. Preparation and Decontamination of Equipment

The plastic churn bucket is to be thoroughly cleaned prior to each sampling trip. All parts inside and out will be scrubbed with a synthetic bristled non-metallic brush and a mild solution of phosphate free laboratory type soap. All parts will be rinsed with tap water to remove all soap residue and followed with a liberal final rinse of deionized water. Equipment should be air dried, assembled and stored in a manner to prevent any contamination.

Field cleaning of the churn bucket will consist of triple rinsing them with river water prior to sample collection.

2.2.3.2. Selection and Preparation of Sample Containers

Disposable plastic sample containers, that are pre-cleaned and sealed, are used for conventional parameters. Amber glass bottles with Teflon-lined lids are used for pesticide samples.

2.2.3.3. Sample Container Types, Field Filtering, Preservation and Holding Times

Table 3 lists the container types that will be used, samples that will be filtered in the field, sample preservation requirements, and holding times for each of the parameters to be analyzed. Samples collected for dissolved metals will be filtered in the field. A field ready peristaltic pump will be used to obtain the filtered sample. The pump will use silicon tubing and a disposable 0.45 micron filter. The filtered sample will be obtained by placing the suction line of the pump directly into the churn bucket and the return line with filter into the sample bottle.

Approximately 1-liter of water will be pumped through the filter for dissolved metals. If blank or duplicate samples are to be collected, the same filtering setup will be used. Sample preservation will be done in the field as soon as possible after sample collection. Acid preservatives are carried in the field in sealed ampoules.

2.2.4. Flow Determination

Flow at the seven sites at the time of sampling will be determined from releases discharged from Ft. Randall and Gavins Point Dams and discharge recorded at gaging stations as described in Table 4.

Table 3. Required sample container types, filtration, preservation, and holding times.

Container Label Designation	Parameters to be Analyzed	Container Type	Field Filtered	Preservation	Holding Time
General Chemistry	Total Suspended Solids Alkalinity Chloride Hardness (Calculated)	Plastic, 1 Liter	No	Avoid air space Chill sample to 4°C	7 days 14 days 28 days 28 days
Nutrients	Total Ammonia Nitrate/Nitrite Total Kjeldahl Nitrogen Total Phosphorus Total Organic Carbon Chemical Oxygen Demand	Plastic, 1 Liter	No	Sulfuric Acid to pH < 2, Chill sample to 4°C	28 days 28 days 28 days 28 days 28 days 28 days
Pesticides, Immunoassay	Alachlor Atrazine Metolachlor	Amber Glass 250ml Teflon-lined Lid	No	Chill sample to 4°C	7 days 7 days 7 days
Pesticides, Full Scan	25 Pesticides (See Table 2)	Amber Glass 1 Liter Teflon-lined lid	No	Chill sample to 4°C	7 days (Pre-extraction) 40 days (post-extraction)
Metals, Dissolved	Ca, Mg, Na Ag, As, Cd, Cr, Cu, Ni, Pb, Hg, Zn	Plastic, 1 Liter	Yes	Nitric Acid to pH < 2, Chill sample to 4°C	6 months
Metals, Total	Se, Hg	Plastic, 1 Liter	No	Nitric Acid to pH < 2, Chill sample to 4°C	6 months

Table 4. Flow determination at the seven water quality monitoring stations.

Station Number	Location	Gage Number	Gage Type	Flow Determination
1MORRR0851	Missouri River near Verdel	USGS 06453620	Stage	Flow will be estimated as the discharge released from Ft. Randall Dam. Discharge from Ponca Creek (USGS 06453600) and Choteau Creek (USGS 06453255) can be added if significant.
1MORRR0774	Missouri River near Maskell	USGS 06478526	Stage	Flow will be estimated by adding the Gavins Pt. Dam release discharge plus the discharge from the James River (USGS gage 06478500).
1MORRR0753	Missouri River at Ponca State Park	USACE PONE	Stage	Flow will be estimated by adding the Gavins Pt. Dam release discharge plus the discharge from the James River (USGS gage 06478500) and the Vermillion River (USGS gage 06479010).
1MORRR0691	Missouri River at Decatur	USGS 06601200	Discharge	From gage 06601200.
1MORRR0619	Missouri River at Omaha	USGS 06610000	Discharge	From gage 06610000.
1MORRR0563	Missouri River at Nebraska City	USGS 06807000	Discharge	From gage 06807000.
1MORRR0498	Missouri River at Rulo	USGS 06813500	Discharge	From gage 06813500.

2.3. SAMPLE HANDLING, CUSTODY, AND TRANSPORT

2.3.1. Example Sample Tag

Each sample container requires an affixed sample tag providing information on sample type, location, date, and time. Sample tags should be filled out (except for time) prior to going to the field to collect the samples. Sample tags are to be prepared in accordance with USACE – Water Quality Unit's SOP Number WQ-24103, "Identification and Documentation of Water Samples for Laboratory Analysis" (USACE, 2004c).

General Water Sample Tag:

SAMPLE ID:			
SITE TYPE CODE:			
SAMPLE COLLECTION & PRESERVATION:			
Date:		**Time:**	
Unfiltered:		**Filtered:**	
H_2SO_4:	**HNO_3:**	**$MgCO_3$:**	**Lugol's:**
BOTTLE CODE:			
COMMENTS:			

2.3.2. Sample Handling, Transport, and Delivery to the Laboratory

Upon completion of sample collection, preservation, and tagging, those samples requiring chilling to 4° C should be stored in an iced cooler. Once back at the vehicle, combine recently collected samples with those from other sites adding ice when necessary. Samples are to be at all times stored in an upright condition. For this project, collected samples will usually be transported to the appropriate laboratories by the personnel who collected the samples. If someone else delivers the samples to the laboratory it will be noted on the analytical request form.

An Analytical Request Form (ARF) will be completed and submitted with all samples delivered to the laboratory. The ARF to be used is shown in Attachment 2. The ARF, in addition to specifying the analysis required, serves as a chain-of-custody between the personnel collecting the sample and the laboratory receiving the samples. ARF's are to be prepared in accordance with USACE – Water Quality Unit's SOP Number WQ-24103, "Identification and Documentation of Water Samples for Laboratory Analysis" (USACE, 2004c).

Laboratory personnel should be alerted an appropriate time in advance of when samples are going to be collected and delivered so necessary arrangements for sample receipt can be made.

Samples delivered to the USACE/ECB Laboratory will be taken to the 4th floor of the laboratory, removed from coolers, and grouped by sample location. This will provide an accurate accounting of samples collected and allow for ease of log-in by laboratory personnel. Laboratory personnel will compare the physical samples to information on the ARF, sign and date the ARF, and provide a copy. The original ARF will be retained by laboratory. Once samples are logged-in they are to be stored in a walk-in cooler maintained at 4° C until analysis is completed. Samples are retained for at least the period of their holding time after analysis is completed.

2.4. ANALYTICAL METHODS

Table 5 lists the methods that will be used by the USACE/ECB Laboratory to analyze the samples for the required detection and reporting limits.

Table 5. Methods, Detection Limits, and Reporting Limits for Analyses Conducted by the USACE/ECB Laboratory.

Analyte	Method	Detection Limit	Lower Reporting Limit
Total Suspended solids	EPA - 160.2	4 mg/l	10 mg/l
Hardness (Calculated)	SM - 2340B	0.4 mg/l	1.2 mg/l
Alkalinity	EPA - 310.2	7 mg/l	20 mg/l
Chloride	EPA - 300.0 / 325.2	1 mg/l	3 mg/l
Total Ammonia	EPA - 350.1	0.01 mg/l	0.1 mg/l
Nitrate/Nitrite	EPA - 300.0 / 353.2	0.02 mg/l	0.1 mg/l
Total Kjeldahl Nitrogen	EPA - 351.2	0.1 mg/l	0.2 mg/l
Total Phosphorus	EPA - 300.0 / 365.4	0.01 mg/l	0.02 mg/l
Total Organic Carbon (TOC)	EPA - 9060	0.05 mg/l	0.25 mg/l
Chemical Oxygen Demand (COD)	EPA - 410.4	3 mg/l	10 mg/l
Pesticide – Immunoassay Alachlor, Atrazine, Metolachlor	Immunoassay	0.05 ug/l	0.1 ug/l
Pesticide – Full Scan Acetochlor, Alachlor, Atrazine, Benfluralin, Butylate, Chlorpyrifos, Cyanazine, Cycloate, EPTC, Hexazinone, Isopropalin, Metolachlor, Metribuzin, Molinate, Oxadiazon, Oxyfluorfen, Pebulate, Pendimethalin, Profluralin, Prometon, Propachlor, Propazine, Simazine, Trifluralin, Vernolate	EPA - 507	0.05 ug/l	0.1 ug/l
Metals:			
Calcium (Ca), dissolved	EPA - 6010B	100 ug/l	300 ug/l
Magnesium (Mg), dissolved	EPA - 6010B	40 ug/l	120 ug/l
Sodium (Na), dissolved	EPA - 6010B	200 ug/l	400 ug/l
Arsenic (As), dissolved	EPA - 6010B	3 ug/l	15 ug/l
Cadmium (Cd), dissolved	EPA - 6010B	0.5 ug/l	2.5 ug/l
Chromium (Cr), dissolved	EPA - 6010B	2 ug/l	10 ug/l
Copper (Cu), dissolved	EPA - 6010B	2 ug/l	10 ug/l
Mercury (Hg), dissolved	EPA - 7470A	0.02 ug/l	0.1 ug/l
Mercury (Hg), total recoverable	EPA - 7470A	0.02 ug/l	0.1 ug/l
Nickel (Ni), dissolved	EPA - 6010B	3 ug/l	10 ug/l
Lead (Pb), dissolved	EPA - 6010B	2 ug/l	10 ug/l
Selenium (Se), total recoverable	EPA - 6010B	4 ug/l	20 ug/l
Silver (Ag), dissolved	EPA - 6010B	1 ug/l	5 ug/l
Zinc (Zn), dissolved	EPA - 6010B	3 ug/l	10 ug/l

A maximum laboratory turn-around time of 60 days is required. A turn-around time of 60 days or less is needed to implement the identified quality control measures for field activities (i.e., assessment of field quality control samples – field duplicates and blanks, and data completeness checks). Turn-around times greater than 60 days will not allow for the timely identification of generated data that do not meet the defined data quality control measures.

2.5. QUALITY CONTROL

2.5.1. Quality Control of Field Activities

2.5.1.1. Adherence to Standard Operating Procedures (SOPs)

Where applicable, field measurements and samples will be collected in accordance with SOPs developed by the USACE – Omaha District's Water Quality Unit. Any data collection that is not addressed by existing SOPs will follow the procedures described in the Sampling Methods Section (2.2) of this SAP. All field measurement devices will be appropriately calibrated or verified for each sampling trip.

2.5.1.2. Quality Control Samples

Field quality control samples that will be utilized by this project include: field blanks and collocated samples (i.e., duplicate samples). A field blank will be created and submitted to the laboratory on a monthly basis. A duplicate sample will be collected each month at one of the six monitoring locations.

2.5.1.3. Data Quality Indicators and Measurement Quality Objectives

Measurement quality objectives (MQO) are established for the following data quality indicators (DQI): Precision, Bias, Completeness, Representativeness, and Comparability.

Precision

The precision of the field methods used for collecting samples will be assessed using the duplicate field quality control samples. The difference in analytical results for the collocated samples (i.e., site and duplicate samples) will be quantified as the relative percent difference (RPD) between the paired samples. The RPD for the collocated samples will be calculated as follows:

$$\text{RPD} = 100\%\left(\frac{|x1 - x2|}{\bar{x}}\right) \qquad \textit{(equation 1)}$$

where: $x1$ and $x2$ are the values of the original and duplicate samples, and
$\bar{x}$ is the mean of the two values.

RPD values are evaluated according to the MQOs given in Table 6. When RPD values indicate "out-of-control" conditions (Table 6) the following actions will be undertaken:

1) Identify any deviations from sample collection procedures identified in SAP and correct.
2) Identify any deviations from stated laboratory analytical procedures and address if all field procedures are properly followed.
3) Track future compliance to determine if outlier situation occurred if all procedures are properly being followed,

4) Consider revising sample collection methods or change data quality expectations if future conditions remain out-of-control.

Table 6. MQOs for Precision.

RPD Value	$\bar{x}$ (from Equation 1)	Control Measures to be Taken
< 20%	-----	None.
>20% and < 100%	< 10 times the detection limit	None.
> 100%	< 10 times the detection limit	Take corrective action (see text).
> 20%	> 10 times the detection limit	Take corrective action (see text).

Bias (Accuracy)

The bias of field data collection methods will be assessed using the field blank quality control samples. The MQO for bias is that all reported results should be less than the method detection limit for the analyzed parameter. If the reported value is greater than the detection limit the following actions will be undertaken:

1) Identify any deviations from sample collection procedures identified in SAP and correct.
2) Identify any deviations from stated laboratory analytical procedures and address if all field procedures are properly followed.
3) Track future compliance to determine if outlier situation occurred if all procedures were properly followed.
4) Check any reagents used to preserve samples for contamination if future conditions remain out-of-control.
5) Consider revising sample collection methods or change data quality expectations if future conditions remain out-of-control.

Completeness

The MQOs for completeness are given in Table 7. The MQOs reflect the number of samples needed to meet the desired use of the data. Data collection and analysis will be verified in accordance with water quality SOP number WQ-27202, "Data Quality Review" (USACE, 2003b). Missing samples will be identified in a timely manner and addressed by the appropriate Sampling Coordinators. Missing analytical results will be identified and discussed with the laboratory.

Table 7. MQOs for completeness based on a calendar year. Note the first number is the target number of samples and the second number is the minimum number of samples required.

Parameter	Completeness Requirement*	Parameter	Completeness Requirement*
Water Temperature	19 - 16	Total Ammonia	19 - 16
Dissolved Oxygen	19 - 16	Nitrate/Nitrite	19 - 16
pH	19 - 16	Total Kjeldahl Nitrogen	19 - 16
Conductivity	19 - 16	Total Phosphorus	19 - 16
Total Suspended Solids	19 - 16	TOC	19 - 16
Alkalinity	19 - 16	COD	19 - 16
Turbidity	19 - 16	Pesticides, Immunoassay	19 - 16
Chloride	19 - 16	Pesticides, Full Scan	1 - 1
Hardness	4 - 3	Metals	4- 3

* Completeness requirements less than the targeted number of samples represents allowances made for missed samples due to possible severe winter and river ice conditions.

Representativeness

For the purposes of this project, representativeness is defined as how well the sampled population (i.e., collected water quality samples) reflects the target population (i.e., water quality in the Missouri River). Two sources of error may affect the representativeness of the sampled population: sampling error and measurement error.

Sampling error is caused by the natural variability inherent among samples from a population. In surface water quality monitoring situations it is largely dependent on the amount of spatial and temporal variability present in the target population. To address temporal variation, this project is utilizing a systematic sampling design for the collection of the ambient monthly samples. The water quality measurements and samples are to be collected biweekly (April – September), with a minimum separation of 11 days and a maximum separation of 17 days between collected samples; and monthly (October – March), with a minimum separation of 21 days and a maximum separation of 35 days between collected samples. Additional sampling may be conducted under runoff events if it is determined that the biweekly and monthly sampling is not adequately monitoring water quality under runoff conditions. The requirement of a minimum separation between subsequent sample collection is meant to address serial correlation concerns. Spatial variation is being addressed by locating the monitoring sites above and below major tributaries, population centers, and point source dischargers. A previous study suggested that intra-monitoring location variability (i.e., near-surface thalweg versus near-bottom thalweg) and "backwater" versus thalweg is minimal under completely-mixed conditions (USACE 2002b). Therefore, a near-surface, mid-channel thalweg sample is deemed to be representative of overall water quality conditions at the monitoring location.

Measurement error refers to the inaccuracies and errors that can and should be avoided by using sound data collection and analysis techniques. Measurement error will be controlled by ensuring that SOPs or other stated procedures are strictly followed.

Quality control samples (i.e., field blanks and duplicates) that are within control limits will be an indicator that the sampled data is meeting representativeness requirements. Out-of-control quality control samples will be addressed as specified under the discussion of precision and bias. Meeting completeness requirements will help ensure that the sampled population is representative of the water quality conditions that occurred during the monitoring period.

Comparability

Data will be reviewed for comparability by considering factors that might affect the similarity of data from a sampled site through time. This will include reviewing collected data to assure sample locations, parameters, collection procedures, method of analyses, and method detection limits remain consistent throughout the project. Any inconsistencies found in sample collection and analyses will be appropriately addressed. Any unavoidable deviations in collection and analysis procedures will require written documentation and an addendum to the SAP for the project.

2.5.2. Quality Control of Laboratory Analysis

2.5.2.1. Laboratory Turn-Around Time

A maximum laboratory turn-around time of 30 days is required. A turn-around time of 30 days or less is needed to implement the identified quality control measures for field activities

(i.e., assessment of field quality control samples – field duplicates and blanks, and data completeness checks). Turn-around times greater than 30 days will not allow for the timely identification of generated data that do not meet the defined data quality control measures.

2.5.2.2. Adherence to Analytical Methods and Standard Operating Procedures

All samples will be analyzed in accordance with the analytical methods identified in Section 2.4 of this SAP. Laboratory equipment will be maintained and calibrated in accordance with the USACE/ECB Laboratory's SOPs for equipment calibration and maintenance.

2.5.2.3. Quality Control Samples and Data Quality Indicators

Laboratory quality control samples and data quality indicators will be utilized in accordance with the ECB's Laboratory Quality Assurance Manual. Routine internal quality control checks are placed in the measurement system to assess the quality of the data generated. These checks typically include: with each preparative batch, a Method Blank, a Matrix Spike and Matrix Spike Duplicate, a Laboratory Duplicate, and a Laboratory Control Sample. Inclusion of the Matrix Spike, Matrix Spike Duplicate and Laboratory Duplicate are contingent on sufficient sample material being provided. In addition to the checks within the preparative batch there are analysis batch checks that are also completed (retained on file by the laboratory, but typically not reported in a standard data package) including Calibration Blanks and Continuing Calibration Verifications. Additional samples are analyzed periodically (results retained on file) and may include reagent blanks, second source check standards and other performance checks. External quality control checks are provided in the form of Performance and System Audits and Surveillance. For a more complete description of these checks, including their frequency of measurement, acceptance criteria and corrective action protocol, refer to the USACE/ECB Laboratory Quality Management Manual (USACE, 2001).

Sample results that are not within the range of typical expectation values for each parameter, as identified in Attachment 6.4, will be identified at the time of either field or laboratory analysis measurement. These identified measurements will be verified by a review of the instrumental data and supporting quality control samples and may require additional measurements. Analytical results that are verified to be outside the expectation range will also be checked by confirming that aliquots samples used for laboratory analysis are properly labeled.

2.5.3. Project Synopsis Sheet

A Project Synopsis Sheet is provided as Attachment 4. The Synopsis Sheet provides the project number, a listing of the monitoring stations associated with the project, targeted frequency of sample collection, field measurements to be taken, parameters to be analyzed, and the minimum analytical and reporting limits required. The Project Synopsis Sheet will be used by the Water Quality Unit and ECB Laboratory to identify data expectations.

2.6. FIELD INSTRUMENT/EQUIPMENT CALIBRATION AND MAINTENANCE

Water quality measurements will be collected in the field with a Hydrolab 4. Calibration and maintenance will be conducted in accordance with SOP Number WQ-21201, "Using a Hydrolab 4 to Directly Measure Water Quality" (USACE, 2004a).

An additional Hydrolab will remain calibrated and maintained as a back-up in the event of equipment failure. Annually, the equipment will be sent to the Hydrolab Company for maintenance and factory calibration. Recalibration or repair sheets will be kept in a log for each Hydrolab at USACE's Water Quality Laboratory.

2.7. INSPECTION/ACCEPTANCE OF FIELD SUPPLIES AND CONSUMABLES

All sample bottles will be purchased new and be certified pre-cleaned and sealed.

A deionized water filter is attached to the tap water line at the USACE's Water Quality Laboratory. The tank will be recharged every three months. Every three months sample bottles will be filled from the newly recharged tank and provided to the laboratory for analysis to determine contamination. A record book of these samples will be kept and maintained at the field laboratory.

Standard solutions for calibrating field equipment will be maintained. Conductivity standard solutions of 1,414 and 700 micromhos will be purchased pre-mixed and will be used prior to the expiration date marked on the container. pH standard solutions of 7.0 and 10.0 will be purchased pre-mixed and will not be used beyond their expiration date or "shelf life" after opening.

3. DATA MANAGEMENT, ASSESSMENT, AND REPORTING

3.1. DATA MANAGEMENT

Data collected or analyzed by the USACE will be compiled in Microsoft EXCEL spreadsheets by the Water Quality Unit. Project data to be compiled includes: field sheets, datalogger files, and laboratory analytical results files. The spreadsheets will be compiled on an ongoing basis. Data verification and validation will be completed on the compiled spreadsheets. Once the compiled data has been verified and validated, it will be entered into the USACE Omaha District's DASLER database. A copy will also be emailed to the NDEQ. The Water Quality Unit will upload data from the Omaha District's DASLER database to EPA's national STORET database on a quarterly basis.

3.2. DATA ASSESSMENT AND REPORTING

3.2.1. USACE Data Assessment and Usage

The primary use of the collected data by the USACE will be for preparing the annual report required pursuant to ER 1110-2-8154. The collected data will also serve as a database for developing required project-specific reports. Data assessment to support the preparation of annual and project-specific reports will include: 1) description of existing water quality conditions, 2) water quality standards attainment assessment (i.e., beneficial use support), 3) water quality trend assessment, 4) identification of water quality concerns, 5) assessment of USACE water control operations on water quality, and 6) assessment of implemented measures to enhance water quality. Statistical methods that will be utilized as part of the data assessment include: calculating descriptive and comparative statistics, hypothesis testing, and trend analysis. The USACE will utilize the NDEQ's methods for assessing beneficial use support.

3.2.2. NDEQ Data Assessment and Usage

Data generated from this project will be used by the NDEQ to meet its 305(b) reporting requirements.

4. DATA QUALITY REVIEW

Data quality review is the process for assuring that data verification and validation will be implemented in an objective and consistent manner. Data verification and validation is the conformation by examination and objective evidence that specific requirements of the SAP and intended use of the data have been fulfilled. Data verification is the process of evaluating the completeness, correctness, and conformance of a specific data set against the method, procedural, or contractual requirements. Data validation is an analyte- and sample-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance (i.e., verification) to determine the analytical quality of a specific data set.

4.1. DATA VERIFICATION AND VALIDATION METHODS EMPLOYED BY THE USACE

The USACE will address data verification and validation in accordance with water quality SOP number WQ-27202, “Data Quality Review” (USACE, 2003b).

4.2. RECONCILIATION WITH QAMPP/SAP REQUIREMENTS

Data quality review will be based on meeting the project’s data quality objectives. If data verification and validation indicate that any data quality objectives can’t be achieved, that information will be provided to the USACE and NDEQ Project Coordinators.

5. REFERENCES

Nebraska Department of Environmental Quality. 2001. Surface water quality monitoring strategy. CPP Document Number 2.1. Water Quality Division, Nebraska Department of Environmental Quality, Lincoln, Nebraska. March, 2001.

U.S. Army Corps of Engineers. 1995. Engineer Regulation (ER) 1110-2-8154, Engineering and design – Water quality and environmental management for Corps civil works projects. U.S. Army Corps of Engineers, Department of the Army, Washington, DC.

_____. **2001.** Laboratory quality management manual. U.S. Army Corps of Engineers Research and Development Center, Environmental Laboratory, Environmental Chemistry Branch, Omaha Facility, Omaha Nebraska.

_____. **2002b.** A scooping study of water quality conditions in the Missouri national recreational river reach from near Gavins Point Dam to Ponca State Park, Nebraska. Water Quality Unit, Water Control and Water Quality Section, Hydrologic Engineering Branch, Engineering Division, Omaha District, U.S. Army Corps of Engineers. March 2002.

_____. **2003a.** Strategic plan and guidance for implementing the Omaha District's water quality management program. Water Quality Unit, Water Control and Water Quality Section, Hydrologic Engineering Branch, Engineering Division, Omaha District, U.S. Army Corps of Engineers, Omaha, Nebraska.

_____. **2003b.** Data quality review. SOP Number: WQ-27202, Issuance Date: Jan – 2003. Water Quality Unit, Water Control and Water Quality Section, Hydrologic Engineering Branch, Engineering Division, Omaha District, U.S. Army Corps of Engineers, Omaha, Nebraska.

_____. **2004a.** Using a "Hydrolab 4" to directly measure water quality (draft). SOP Number: WQ-21201. Water Quality Unit, Water Control and Water Quality Section, Hydrologic Engineering Branch, Engineering Division, Omaha District, U.S. Army Corps of Engineers, Omaha, Nebraska.

_____. **2004b.** Determining secchi depth. SOP Number: WQ-21105. Water Quality Unit, Water Control and Water Quality Section, Hydrologic Engineering Branch, Engineering Division, Omaha District, U.S. Army Corps of Engineers, Omaha, Nebraska.

_____. **2004c.** Identification and documentation of water samples for laboratory analysis. SOP Number: WQ-21105. Water Quality Unit, Water Control and Water Quality Section, Hydrologic Engineering Branch, Engineering Division, Omaha District, U.S. Army Corps of Engineers, Omaha, Nebraska.

Attachment 1. Example Field Sheet

(U.S. Army Corps of Engineers – Omaha District – Water Quality Unit)

FIELD DATA SHEET

Project Name: Nebraska – Missouri River **Project Number:** AMB-NEMORR-001

Trip Number: _____ **Visit Number:** 1

Site Location: Missouri River near Maskell, NE (Mid-Channel) **Date:** _____

Station Number: 1MORRR0774A **Collectors:** _____

GPS MEASUREMENTS (Optional)

GPS Device Used: _____

Latitude: _____ Longitude:_____ Accuracy: _____

GENERAL FIELD OBSERVATIONS (Optional)

Cloud Cover (%) _____ Wind Direction _____ Wind Velocity _____ Air Temp. _____

Other: _____

_____

WATER MEASUREMENTS

Discharge (cfs)* _____ Gage Height (Ft): _____

Depth to Bottom (Feet): _____ Secchi Depth (Inches): _____

Near-Surface Measurements:

Water Temperature (°C)		Dissolved Oxygen (mg/l)	
pH (S.U.)		Dissolved Oxygen (% Sat.)	
Conductivity (umhos)		Turbidity (NTU)	

* Discharge Calculation = GPT Dam + James River = _____ + _____ = _____

WATER QUALITY SAMPLES COLLECTED

Sample Type Code	Collection Time
NEARSURF	

_____ Duplicate sample collected. *(Check if a QC duplicate sample was collected at this site.)*

COMMENTS:

Attachment 2. Example Analytical Request Form

(U.S. Army Corps of Engineers – Omaha District – Water Quality Unit)

ANALYTICAL REQUEST FORM

Project Name: Nebraska – Missouri River Project **Number:** AMB-NEMORR-001

Trip Number: _____ **Visit Number:** 1

Samples to be Analyzed:

Station Number	Station Location	Sample Type Code	Collection Date	Collection Time	Major Runoff at Site	Containers, Filtration, and Preservatives*					
						UF	UFA1	UFA2	P1	P2**	P3**
1FTRTW1__	Ft. Randall Tailwaters	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0851__	Mo. River near Verdel	NEARSURF				1	1	May	1	Qrtly	Qrtly
1GPTTW1__	Gavins Point Tailwaters	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0774__	Mo. River near Maskell	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0753__	Mo. River near Ponca	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0691__	Mo. River at Decatur	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0619__	Mo. River at Omaha	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0563__	Mo. River at Neb. City	NEARSURF				1	1	May	1	Qrtly	Qrtly
1MORRR0498__	Mo. River at Rulo	NEARSURF				1	1	May	1	Qrtly	Qrtly
MORDUPL	Duplicate	QCDUP						May		Qrtly	Qrtly
MORFBLK	Field Blank	QCFBK						May		Qrtly	Qrtly

*UF = Unfiltered, 1 Liter Plastic Bottle; UFA1 = Unfiltered, 125 ml Amber Bottle (Immunoassay); UFA2 = Unfiltered, 1 Quart Amber Bottle (Pesticide Scan); F = Filtered, 250 ml Plastic Bottle; P1 = Unfiltered, Preserved (H_2SO_4), 1 Liter Plastic Bottle; P2 = Filtered, Preserved (HNO_3), 1 Liter Plastic Bottle; P3 = Unfiltered, Preserved (HNO_3), 1 Liter Plastic Bottle; Chl = Test Tube with Filter (Chlorophyll).

** Metals are analyzed quarterly.

Total Number of Sample Containers Delivered to Lab: _____

Samples Collected By: _____

Samples Delivered By: _____

Samples Received By: _____ **Date/Time Received:** _____

Laboratory Analyses to be Performed:

General Chemistry	Nutrients	Chlorophyll	Pesticides (Immunoassay)	Pesticides (Scan)	Metals
X	X	X	X	May Only	Quarterly

NOTE: SEE PROJECT SYNOPSIS SHEET FOR SPECIFIC PARAMETERS TO BE ANALYZED.

☐ If box checked, analyze additional parameters identified below:

Parameter	Required Detection Limit

Comments:

Attachment 3. Quantification Limits for the Identification of Possible Outliers

Field Measurements

If field measurement below lower bound or above upper bound, re-measure parameter.

Parameter	Lower Bound	Upper Bound
Water Temperature (°C)	0	30
pH	6.5	9.0
Conductivity	500	1,000
Dissolved Oxygen (% Sat.)	50	120
Turbidity (NTU)	1	1,000*

* If field measured turbidity > 1,000 NTUs, request laboratory analysis for turbidity.

Laboratory Analysis – Field Blanks

If analytical results above detection limit for appropriate parameters, rerun analysis of sample and verify that the field blank aliquot sample is properly identified.

Laboratory Analysis – Environmental Samples

If analytical results below lower bound or above upper bound, rerun analysis of sample for appropriate parameter (note allowances made for samples influenced by "runoff").

Parameter	Lower Bound	Upper Bound
Total Kjeldahl Nitrogen as N (mg/l)	none	3.0*
Total Ammonia as N (mg/l)	none	0.6*
Nitrate-Nitrite as N (mg/l)	none	2.0*
Total Phosphorus as P (mg/l)	none	2.0*
Total Organic Carbon (mg/l)	none	5.0*
Chemical Oxygen Demand (mg/l)	none	50*
Total Suspended Solids (mg/l)	none	1,000*
Turbidity (NTU)	none	1,000*
Chlorides (mg/l)	none	25*
Alkalinity (mg/l)	100	300
Pesticides – Immunoassay (ug/l) (i.e., Atrazine, Alachlor, Metolachlor)	none	10*
Pesticide Scan (ug/l)	none	5*
Calcium, dissolved (mg/l)	20	100
Magnesium, dissolved (mg/l)	10	50
Sodium, Dissolved (mg/l)	20	100
Arsenic, Dissolved (ug/l)	none	10
Cadmium, Dissolved (ug/l)	none	2
Chromium, Dissolved (ug/l)	none	100
Copper, Dissolved (ug/l)	none	10
Mercury, Total (ug/l)	none	0.05
Mercury, Dissolved (ug/l)	none	1
Nickel, Dissolved (ug/l)	none	100
Lead, Dissolved (ug/l)	none	5
Selenium, Total (ug/l)	none	5
Silver, Dissolved (ug/l)	none	5
Zinc, Dissolved (ug/l)	none	100

* If major runoff noted at site, no upper bound is applicable.

Attachment 4. Project Synopsis Sheet

Project Name: Missouri River – Nebraska

Project Number: AMB-NEMORR-001

Monitoring Stations Associated With Project:

Station Number*	Station Name
1FTRTW1 (A or B)	Missouri River at Fort Randall Dam Tailwaters
1MORRR0851 (A or B)	Missouri River near Verdel, Nebraska
1GPTTW1 (A or B)	Missouri River at Gavins Point Dam Tailwaters
1MORRR0774 (A or B)	Missouri River near Maskell, Nebraska
1MORRR0753 (A or B)	Missouri River near Ponca, Nebraska
1MORRR0691 (A or B)	Missouri River at Decatur, Nebraska
1MORRR0619 (A or B)	Missouri River at Omaha, Nebraska
1MORRR0563 (A or B)	Missouri River at Nebraska City, Nebraska
1MORRR0498 (A or B)	Missouri River at Rulo, Nebraska

* A and B are collection site identifiers: A = mid-channel of river, B = next to riverbank.

Analytical Methods, Sampling Frequency, and Required Detection and Reporting Limits:

Parameter	Sampling Frequency*	Method	Detection Limit	Lower Reporting Limit
Field Measurements	Biweekly/Monthly	WQU SOPs	-----	-----
Total Suspended solids	Biweekly/Monthly	EPA - 160.2	4 mg/l	10 mg/l
Alkalinity	Biweekly/Monthly	EPA - 310.2	7 mg/l	20 mg/l
Chloride	Biweekly/Monthly	EPA - 300.0 /325.2	1 mg/l	3 mg/l
Total Ammonia	Biweekly/Monthly	EPA - 350.1	0.01 mg/l	0.1 mg/l
Nitrate/Nitrite	Biweekly/Monthly	EPA - 300.0 /353.2	0.02 mg/l	0.1 mg/l
Total Kjeldahl Nitrogen	Biweekly/Monthly	EPA - 351.2	0.1 mg/l	0.2 mg/l
Total Phosphorus	Biweekly/Monthly	EPA - 300.0 /365.4	0.01 mg/l	0.02 mg/l
Total Organic Carbon (TOC)	Biweekly/Monthly	EPA - 9060	0.05 mg/l	0.25 mg/l
Chemical Oxygen Demand (COD)	Biweekly/Monthly	EPA - 410.4	3 mg/l	10 mg/l
Pesticide – Immunoassay Alachlor, Atrazine, Metolachlor	Biweekly/Monthly	Immunoassay	0.05 ug/l	0.1 ug/l
Pesticide – Full Scan Acetochlor, Alachlor, Atrazine, Benfluralin, Butylate, Chlorpyrifos, Cyanazine, Cycloate, EPTC, Hexazinone, Isopropalin, Metolachlor, Metribuzin, Molinate, Oxadiazon, Oxyfluorfen, Pebulate, Pendimethalin, Profluralin, Prometon, Propachlor, Propazine, Simazine, Trifluralin, Vernolate	Annually (May)	EPA - 507	0.05 ug/l	0.1 ug/l
Metals:	Quarterly (March, June, September, December)			
Calcium (Ca), dissolved		EPA - 6010B	100 ug/l	300 ug/l
Magnesium (Mg), dissolved		EPA - 6010B	40 ug/l	120 ug/l
Sodium (Na), dissolved		EPA - 6010B	200 ug/l	400 ug/l
Arsenic (As), dissolved		EPA - 6010B	3 ug/l	15 ug/l
Cadmium (Cd), dissolved		EPA - 6010B	0.5 ug/l	2.5 ug/l
Chromium (Cr), dissolved		EPA - 6010B	2 ug/l	10 ug/l
Copper (Cu), dissolved		EPA - 6010B	2 ug/l	10 ug/l
Mercury (Hg), dissolved		EPA - 7470A	0.02 ug/l	0.1 ug/l
Mercury (Hg), total recoverable		EPA - 7470A	0.02 ug/l	0.1 ug/l
Nickel (Ni), dissolved		EPA - 6010B	3 ug/l	10 ug/l
Lead (Pb), dissolved		EPA - 6010B	2 ug/l	10 ug/l
Selenium (Se), total recoverable		EPA - 6010B	4 ug/l	20 ug/l
Silver (Ag), dissolved		EPA - 6010B	1 ug/l	5 ug/l
Zinc (Zn), dissolved		EPA - 6010B	3 ug/l	10 ug/l

* Biweekly samples will be collected from April - September and monthly samples will be collected from October - March.

Attachment 5. Projected Laboratory Analyses Costs.

Parameter	Frequency of Analysis*	Detection Limit	Lower Reporting Limit	Analysis Cost Per Sample	Annual Analysis Cost
Total Suspended solids	Biweekly/Monthly	4 mg/l	10 mg/l	$17	$323
Alkalinity	Biweekly/Monthly	7 mg/l	20 mg/l	12	228
Hardness (Calculated)	Quarterly	0.4 mg/l	1.2 mg/l	14	56
Chloride	Biweekly/Monthly	1 mg/l	3 mg/l	12	228
Total Ammonia	Biweekly/Monthly	0.01 mg/l	0.1 mg/l	20	380
Nitrate/Nitrite	Biweekly/Monthly	0.02 mg/l	0.1 mg/l	17	323
Total Kjeldahl Nitrogen	Biweekly/Monthly	0.1 mg/l	0.2 mg/l	32	608
Total Phosphorus	Biweekly/Monthly	0.01 mg/l	0.02 mg/l	26	494
Total Organic Carbon (TOC)	Biweekly/Monthly	0.01 mg/l	0.03 mg/l	58	1,102
Chemical Oxygen Demand (COD)	Biweekly/Monthly	3 mg/l	10 mg/l	20	380
Pesticide – Immunoassay Alachlor, Atrazine, Metolachlor	Biweekly/Monthly	0.05ug/l	0.1 ug/l	30	570
Pesticide – Scan Acetochlor Alachlor Atrazine Benfluralin Butylate Chlorpyrifos Cyanazine Cycloate EPTC Hexazinone Isopropalin Metolachlor Metribuzin Molinate Oxadiazon Oxyfluorfen Pebulate Pendimethalin Profluralin Prometon Propachlor Propazine Simazine Trifluralin Vernolate	Annually (May)	0.05ug/l	0.1 ug/l	375	375
Metals:	Quarterly				
Calcium (Ca), dissolved	(January, April,	100 ug/l	300 ug/l	20	$80
Magnesium (Mg), dissolved	July, October)	40 ug/l	120 ug/l	20	80
Sodium (Na), dissolved		200 ug/l	400 ug/l	20	80
Arsenic (As), dissolved		3 ug/l	15 ug/l	20	80
Cadmium (Cd), dissolved		0.5 ug/l	2.5 ug/l	20	80
Chromium III (Cr), dissolved		2 ug/l	10 ug/l	20	80
Copper (Cu), dissolved		2 ug/l	10 ug/l	20	80
Mercury (Hg), dissolved		0.02 ug/l	0.1 ug/l	40	160
Mercury (Hg), total recoverable		0.02 ug/l	0.1 ug/l	40	160
Nickel (Ni), dissolved		3 ug/l	10 ug/l	20	80
Lead (Pb), dissolved		2 ug/l	10 ug/l	20	80
Selenium (Se), total recoverable		4 ug/l	20 ug/l	35	140
Silver (Ag), dissolved		1 ug/l	5 ug/l	20	80
Zinc (Zn), dissolved		3 ug/ll	10 ug/l	20	80
TOTAL ANNUAL LABATORY ANALYSES COSTS PER AMBIENT SITE					$6,407

* Winter sampling contingent upon ice conditions.

Note: If problems occur with field measurement of turbidity, it will be analyzed in the laboratory at a cost of $10 per analysis.

Total Costs:

9 Ambient Sites: 9 x $6,407 = $57,663
QA/QC Samples: 1 x $6,407 = $6,407
TOTAL COST: $57,663 + $6,407 = $64,070

USACE Costs = $15,500; Nebraska Department of Environmental Quality Costs = $48,600